U. S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Metabetaeus lohena*

COMMON NAME: Anchialine pool shrimp

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: September 2005

STATUS/ACTION:

____ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

____ New candidate

__X_ Continuing candidate

____ Non-petitioned

__X_ Petitioned - Date petition received: May 11, 2004

____ 90-day positive - FR date:

_X__ 12-month warranted but precluded - FR date: May 11, 2005

_N__ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions. During the past 12 months, most of our national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov).

__X__ Listing priority change

Former LP: __2__

New LP: __5__

Date when the species first became a Candidate (as currently defined): 10/25/1999

____ Candidate removal: Former LP: ____

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act's definition of "species."

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Crustaceans; Family Alpheidae (snapping shrimp)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Oahu , Maui and Hawaii

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, islands of Oahu, Maui and Hawaii

LAND OWNERSHIP
Metabetaeus lohena is reported on the islands of Maui, Hawaii, and Oahu. On Maui and Hawaii, the pools are located on State owned lands in the State Natural Area Reserve System. On Oahu, the pool is on land owned by the City and County of Honolulu.

LEAD REGION CONTACT: Paul Phifer (503) 872-2823, paul_phifer@fws.gov

LEAD FIELD OFFICE CONTACT: Pacific Islands Fish & Wildlife Office, Lorena Wada (808) 792-9440, lorena_wada@fws.gov

BIOLOGICAL INFORMATION:

Species Description: *Metabetaeus lohena* grows up to 18 millimeters (0.7 inches) in length, and body coloration ranges from pale-pink to brilliant red. There is a conspicuous mandibular (mouthpart) spot (Banner and Banner 1960). Its chelae (claws) are relatively large and conspicuous. Locomotion is accomplished by crawling along the substrate. It is primarily a predator, feeding largely on the more common anchialine pool shrimp *Halocaridina rubra* (Holthuis 1973). However, as with most decapods, it may occasionally scavenge.

Taxonomy: *Metabetaeus lohena* was described by Holthius in 1973. The US Department of Agriculture's Integrated Taxonomic Information Systems online database considers the taxonomy of this species to be valid and this species is recognized as a valid taxon in Holthuis

(1993).

Habitat: *Metabetaeus lohena* is known to occur in both low and high salinity anchialine pools on the Hawaiian islands of Maui and Hawaii, and possibly on Oahu. Anchialine pools are land-locked bodies of water that occur coastally but are not openly connected to the ocean. They are mixohaline, with salinities ranging from 2 parts per thousandth (ppt) to concentrations just below that of sea water (32 ppt) (Maciolek 1983; Brock *et al*. 1987). Anchialine pools are subject to tidal fluctuations. Except for some records of endemic eels, anchialine pools do not support native species of fish although some species of nonnative fish have been introduced and are currently recognized as problems (see Disease and Predation section below) (Bailey-Brock and Brock 1993; Brock 2004). Although anchialine pools are widespread, being found in areas such as Saudi Arabia, Madagascar, Fiji, and other Indo-Pacific islands, the total area occupied by them globally is extremely small (Maciolek 1983). While a number of species of anchialine shrimp (e.g., *Calliasmata pholidota, Antecaridina lauensis)* have disjunct, global distributions within these habitats, most geographic locations contain some endemic taxa (Maciolek 1983).

Historic and Current Range/Distribution: Historically, *Metabetaeus lohena* has been reported from at least 61 anchialine pools on the islands of Maui, Hawaii, and Oahu, and as recently as 1992, this species was still present in some pools on all three islands (Hawaii Biodiversity and Mapping Program database 2004). Currently it is absent from most surveyed pools (Brock 2004; Hawaii Biodiversity and Mapping Program database 2004). For example, since 1984, this species has been found within only 28 out of the 53 total pools documented originally to contain the species on the island of Hawaii (Hawaii Biodiversity and Mapping Program database 2004). During Brock's (2004) most recent survey of Ahihi-Kinau Natural Area Reserve and Manuka Natural Area Reserve, *M. lohena* was observed in 9 pool groups and 3 pool groups, respectively. It also is currently found in one pool on Oahu. Like other anchialine pool shrimp species, it is believed that this species inhabits an extensive network of water-filled interstitial spaces (cracks and crevices) leading to and from the actual pool, and this trait has precluded researchers from obtaining more accurate population size estimates during surveys for the species (Holthuis 1973; Maciolek 1983). Many of the rare species of anchialine shrimp, including *M. lohena,* have merely been noted as present or absent from pools that have been surveyed (typically with the aid of baiting). Loss of shrimp species from suitable habitat is likely the best, or only, measure of species decline since population sizes are not easily determined (Holthuis 1973; Maciolek 1983).

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range. On the island of Hawaii, Dr. Richard Brock (pers. comms. 1998, 2004) estimates that up to 90 percent of the anchialine pools have been destroyed or permanently altered by human activities. Development of the Kona coastline area on the island of Hawaii in 1985 alone destroyed some 130 anchialine pools (Brock *et al*. 1987). The more recent human modifications of anchialine pools include the bulldozing and filling of pools (Bailey-Brock and Brock 1993). Dumping of refuse and the introduction of nonnative fish (see Disease and

Predation section below) threaten the known populations of *Metabetaeus lohena* and have impacted other anchialine pools on this island (R. Brock, *in litt*. 1985; Brock 2004).

The Maui pools known to contain *Metabetaeus lohena*, were modified by early Hawaiians and later inhabitants of the area, but are within the State Ahihi-Kinau NAR. Dumping does occur in the NAR, and while none has yet occurred within the pools, this threat remains a possibility (Brock 2004).

Damage from use of anchialine pools for swimming and bathing has been documented in the Hawaiian Islands (R. Brock, *in litt*. 1985; Brock 2004). Similar impacts to the anchialine pools on the island of Hawaii are possible but have not, at present been documented. Swimming and bathing is not believed to be a serious problem in the Maui pools where *Metabetaeus lohena* is reported to occur.

Development activities on the Ewa Plain on the island of Oahu have impacted anchialine pools in that area and are known to currently threaten at least one pool (R. Brock, pers. comm. 1998).

Habitat alteration due to recreational use is known to have occurred on the island of Hawaii and Oahu and is often evident in the amount of garbage that has been dumped in these pools (Brock 2004). Although not a growing threat, a number of anchialine pools are commonly used as swimming holes and have been used as birthing pools (R. Brock, *in litt*. 1985).

B. Over-utilization for commercial, recreational, scientific, or educational purposes.
The U.S. Fish and Wildlife Service (Service) has become aware of companies and private collectors using anchialine pool shrimp and related shrimp species for self-contained aquariums similar to those marketed by Ecosphere Associates, Inc. (www.eco-sphere.com 2004). One company located in Hawaii, Fuku Bonsai, has already begun using Hawaiian anchialine pool species for the aquarium hobby market (www.fukubonsai.com 2004). For commercial purposes, currently only a State Commercial Marine License is required to collect anchialine pool shrimp (collection is prohibited in State Natural Area Reserves). The potential impacts to this species from collection for trade and business are difficult to estimate, however, the possibility of impact is something that must be considered.

C. Disease or predation.
In Hawaii, predation by introduced nonnative fish is considered to be the greatest threat to native shrimp within anchialine pool ecosystems (Bailey-Brock and Brock 1993; Brock 2004). Marine fish are occasionally seen in isolated pools, indicating that people are introducing these fish into the pools (Bill Evanson, Hawaii Department of Land and Natural Resources, pers. comm. 1998). Anchialine pools have been used to discard or hold bait-fish and/or aquarium fish (Bailey-Brock and Brock 1993). These fish either directly consume the native shrimp or as with introduced tilapia (*Oreochromis mossambica*), out-compete the native herbivorous species of shrimp that typically serve as the prey-base for the rarer, predatory species of shrimp. Introduction of nonnative fish including bait-fish into such

pools may have been a major contributor to the decline of these shrimp. No alien fish species were seen during the most recent survey of the pools where these shrimp occur (Brock 2004).

Invasion, with human assistance, of anchialine pools by nonnative fish is a potential threat and is the most significant impact to pool shrimp and their habitat. Within the State NARs, disturbance of the pools is prohibited and informative signs have been placed at the sites. However, there are concerns that this may not be adequate protection. For example, since 1985 signage was used to keep people from entering the Waikoloa Achialine Pond Preserve at Waikoloa, North Kona, Hawaii. Visitors were not allowed into the pool preserve but could walk around the perimeter. In December of 2003, it was discovered that someone had released tilapia and mosquito fish into the system. Within six months time, two thirds of the system had been invaded by the alien fish and all the anchialine pool shrimp disappeared (Brock 2004).

D. The inadequacy of existing regulatory mechanisms.
Although there are no existing regulatory mechanisms that specifically protect this species, the anchialine pools located within the State NARs are protected by state statutes that prohibit the removal of any native organism and the disturbance of pools (Administrative Rules, Sec. 13-209-4 (www.dofaw.net/nars 2004)). The State NARs were created to preserve and protect samples of Hawaiian biological ecosystems and geological formations; and are actively managed and monitored for their unique ecosystems. However, while signs are posted that provide notice to the public that the pools are off-limits to bathers and other activities that could damage the pools, the State's NARs have no funding for proper enforcement to stop such activity.

E. Other natural or manmade factors affecting its continued existence.
Even if the threats responsible for the decline of this species were controlled, the persistence of existing populations is hampered by the small number of extant populations and the small geographic range of the known populations. This circumstance makes the species more vulnerable to extinction due to a variety of natural processes. Small populations are particularly vulnerable to reduced reproductive vigor caused by inbreeding depression, and they may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and ability to cope with environmental change (Lande 1988; Center for Conservation Update 1994). Small populations are also demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio (Lande 1988).

There are no conservation efforts underway to alleviate these threats for this species.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED
The two State NARs, Ahihi-Kinau and Manuka, were established in part, to protect anchialine pools and their unique fauna (Holthuis 1973). Within all State NARs, statutes specifically prohibit the disturbance or removal of any plant or wildlife and the disturbance of any pond or

lake.

SUMMARY OF THREATS:
The primary threats to this species are the loss of habitat due to degradation and predation from nonnative fish. Currently, the species occurs in 13 remaining pool groups. Nine groups of pools are located in the Ahihi-Kinau NAR on Maui, 3 pool groups are located in a State NAR on the island of Hawaii, and 1 pool is located on the island of Oahu. The state statutes prohibit the collection of the species and the disturbance of the pools in State NARs. However, enforcement of these prohibitions is difficult and the negative effects from the introduction of nonnative fish are extensive and happen quickly.

SUMMARY OF REASONS FOR ADDITION, REMOVAL, OR LISTING PRIORITY CHANGE:

The listing priority number is being changed from 2 to 5 because no nonnative fish were observed during surveys conducted for this shrimp in 2004. Therefore, the threat of predation from nonnative fish is non-imminent since it is not currently occurring. In addition, threats to this shrimp form habitat degradation and destruction due to dumping, fill, bulldozing, swimming, and bathing are also non-imminent.

LISTING PRIORITY:

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	**5***
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:
Magnitude:

The single greatest threat to anchialine pool shrimp and their habitat throughout its limited range is the potential introduction of nonnative fish (often with human assistance). Other threats are modification or loss of the anchialine pool habitat by dumping, fill, or recreational activities, and collection of this species for sale or trade.

Imminence:

Threats to *Metabetaeus lohena* from nonnative fish, dumping, fill, recreational activities, and overcollection are non-imminent because they are not on-going. Nonnative fish are not present in the pools in which this species currently occurs. There are no reports of dumping, fill, recreational activities, overcollection in the pools in which this species occurs.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the species' total populations within the time frame of the routine listing process. In addition, the populations within the State Natural Area Reserve System receive some protections under state statutes. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *Metabetaeus lohena* as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

DESCRIPTION OF MONITORING

We conducted literature searches for recent articles on this species and contacted relevant species experts, U.S. Geological Survey-Biological Resources Discipline, State officials with the Department of Land and Natural Resources, Bishop Museum, University of Hawaii, and Auburn University researchers regarding the current status of this species. Additional information on the species' status was added to this update and the existing data regarding the species' status was verified.

This level of monitoring is appropriate to update the status of the species because a thorough literature search was conducted as well as relevant species experts contacted. Information contained in this assessment form was verified by species experts and any new information incorporated. The Hawaii Biodiversity and Mapping Program lists this species as critically imperiled to imperiled (Hawaii Biodiversity and Mapping Program database 2004). This species is not listed in the International Union for Conservation of Nature and Natural Resources Red Data List database (International Union for Conservation of Nature and Natural Resources database 2004).

List of Experts Contacted:

Name	Date	Place of Employment
Richard Brock	July 13, 2005	University of Hawaii

Ronald Englund	July 12, 2005	Bishop Museum
David Foote	July 12, 2005	U.S. Geological Survey, BRD
Betsy Gagne	July 12, 2005	Hawaii Dept of Land and Natural Resources
Thomas Iwai	July 13, 2005	Hawaii Dept of Land and Natural Resources
Michael Kido	July 12, 2005	University of Hawaii
Cedric Muir	July 14, 2005	University of Hawaii
David Preston	July 12, 2005	Bishop Museum
Atlantis Russ	July 14, 2005	University of Hawaii
Scott Santos	July 12, 2005	Auburn University
Michael Yamamoto	July 13, 2005	Hawaii Dept of Land and Natural Resources

List of Databases Searched:

Name	Date
Hawaii Biodiversity and Mapping Program	2004
[Hawaii Natural Heritage Program]	
International Union for Conservation of Nature and Natural Resources	2004
Integrated Taxonomic Information System	2005

COORDINATION WITH STATES

In October 2004 we provided the Division of Forestry and Wildlife Administrator, Paul Conry, with copies of our most recent candidate assessment forms for his review and comment. In addition, copies of the candidate forms were sent to Betsy Gagne, Executive Secretary for the Hawaii Natural Area Reserves System Commission. Ms. Gagne reviewed the information for this species and provided no additional information or corrections (B. Gagne, pers. comm. 2005).

LITERATURE CITED

Bailey-Brock, J.H. and R.E. Brock. 1993. Feeding, reproduction, and sense organs of the Hawaiian anchialine shrimp *Halocaridina rubra* (Atyidae). Pacific Science 47:338-355.

Banner, A.H. and D.M. Banner. 1960. Contributions to the knowledge of the Alpheid shrimp of the Pacific Ocean; Part VII. On *Metabetaeus* Borradaile, with a new species from Hawaii. Pacific Science 14:299-303.

Brock, Richard. 1985. University of Hawaii at Manoa. Letter to the Fish and Wildlife Service, Honolulu, Hawaii.

Brock, Richard. 1998. University of Hawaii at Manoa. Personal communication.

Brock, Richard. 2004. University of Hawaii at Manoa. Personal communication.

Brock, R.E. 2004. Anchialine Resources in Two Hawaii State Natural Area Reserves: Ahihi Kinau, Maui Island and Manuka, Hawaii Island with Recommendations for Their Management. Prepared for the U.S. Fish and Wildlife Service by Environmental Assessment, LLC.

Brock, R.E., J.E. Norris, D.A. Ziemann, and M.T. Lee. 1987. Characteristics of water quality in anchialine ponds of the Kona, Hawaii, coast. Pacific Science 41:200-208.

Center for Conservation Biology. 1994. Nectar, fecundity and conservation planning. Center for Conservation Biology Update, Vol. 8(1): 10 (summer).

Evanson, Bill. 1998. Department of Land and Natural Resources. Personal communication.

Holthuis, L.B. 1973. Caridean shrimps found in land-locked saltwater pools at four Indo-west Pacific localities (Sinai Peninsula, Funafuti Atoll, Maui and Hawaii Islands), with the description of one new genus and four new species. Zool. Verhadenlingen 128:3-55.

Holthuis, L.B. 1993. The recent genera of the Caridean and Stenopodidean shrimps) Crustacea, Decapoda): with an appendix on the order Amphionidacea. National Natuurhistorisch Museum, Leiden. 328 pp.

Lande, R. 1988. Demographic models of the northern spotted owl (*Strix occidentalis caurina*). Oecologia 75: 601-607.

Maciolek, J.A. 1983. Distribution and biology of Indo-pacific insular hypogeal shrimps. Bulletin of Marine Science 33:606-618.

Www.eco-sphere.com. (website) 2004.

Www.fukubonsai.com (website) 2004.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: Acting _____ 11/10/05
Regional Director, Fish and Wildlife Service Date

_____

Concur: _____ August 23, 2006
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review: _____
Conducted by: Lorena Wada, Pacific Islands FWO

Comments:

PIFWO Review
Reviewed by: Christa Russell Date: 10/7/05
Acting Assistant Field Supervisor, Endangered Species

Patrick Leonard Date: 10/11/05
Field Supervisor